EPRI's Water/Energy Sustainability Initiative

Robert Goldstein

New York Regional Energy-Water Workshop

New York, NY, April 20, 2004

Ben Franklin

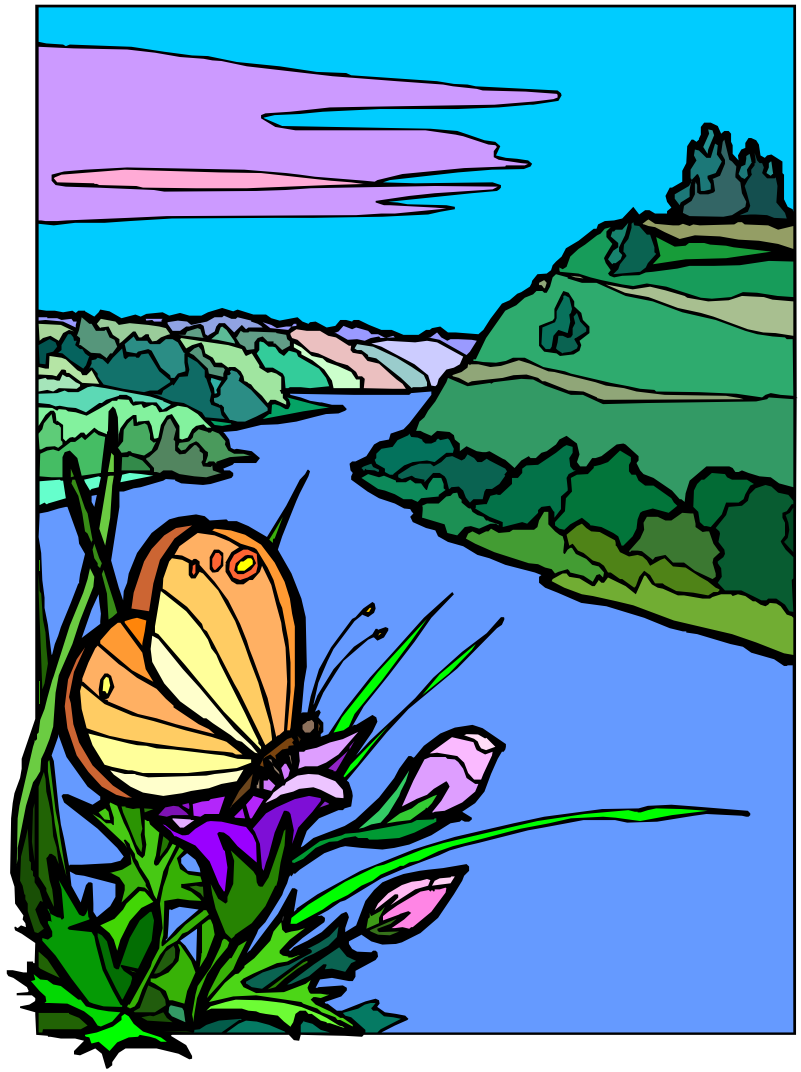
- When the well's dry,

  we know the worth of

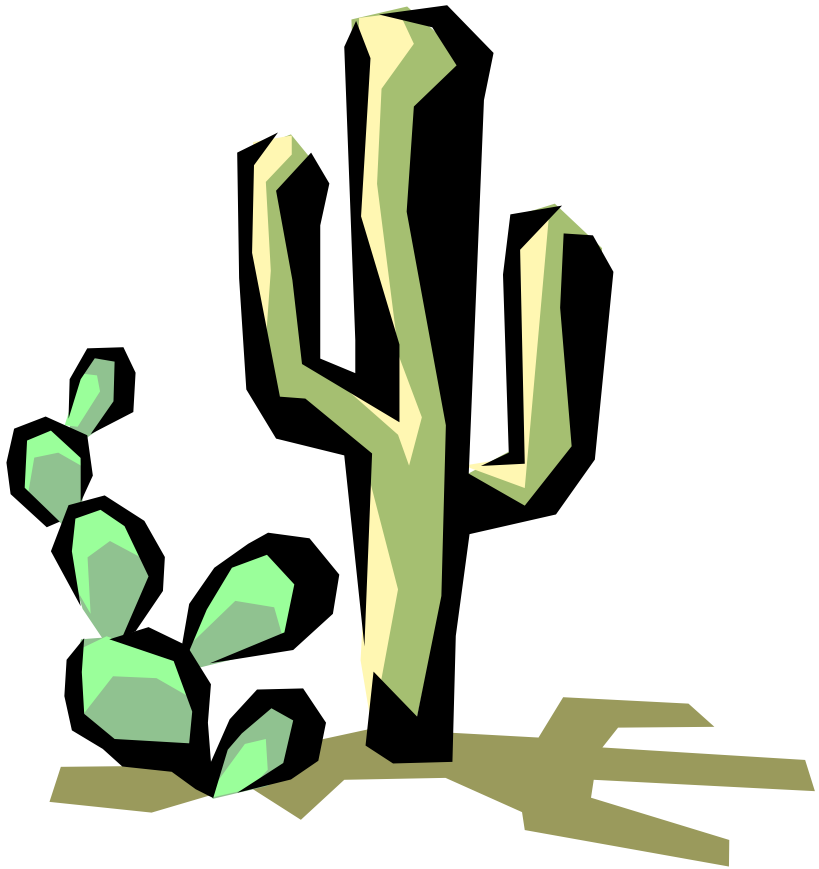
  water.

Themes

- Why EPRI is interested in water sustainability?
- Why energy/water sustainability is a major emerging issue of national and international concern?
- What is EPRI doing?



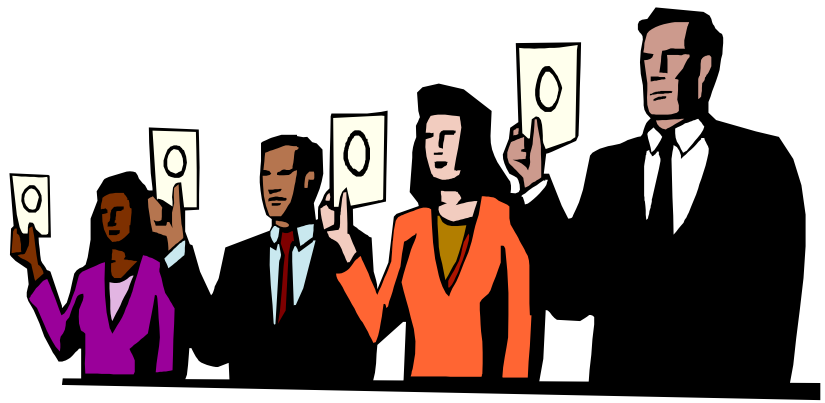
Why is EPRI involved in Water & Sustainability?



- 47 States in the U.S. reported drought conditions in August 2002.

GAO Survey of State Water Managers (2003)

- Under drought conditions, all 45 state water managers who responded to the GAO predicted water shortages that could be "accompanied by severe economic, environmental and social impacts."
- Water managers in 36 states surveyed by the GAO said they anticipate water shortages in the next 10 years under "average water conditions.“



Water Issues in the News

Power Plant Water Issues in Today's News

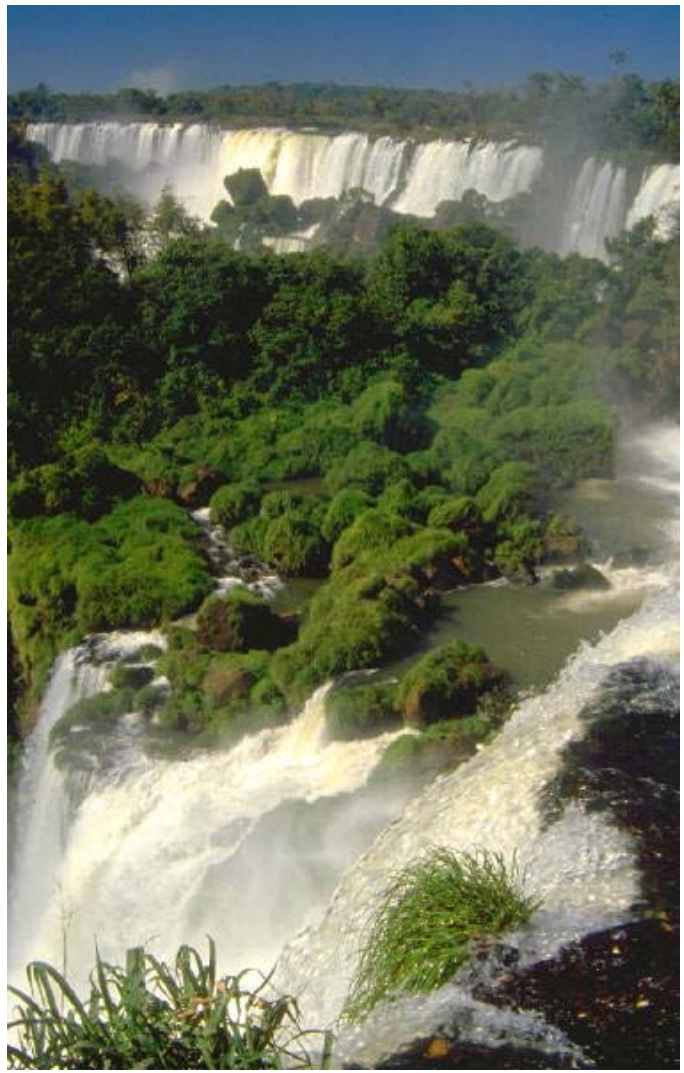
- ***"Company Ends Fight for Power Generator on NJ-NY Border"***
  - The Record, NJ, September 2002
- ***"Official: Plants Would Use Too Much Water"***
  - The Idaho Statesman, ID,July 2002
- ***"Georgia Power Loses Bid to Draw Water from Chattahoochee"***
  - Miami News, February 2002
- ***"EPA Orders Mass. Power Plant to Reduce Water Withdrawals"***
  - Providence Journal, RI, July 2002

Power Plant Water Issues in Today's News

- *"Duke Power Warns Towns in Charlotte, N.C., Area to Cut Water Use"*
  - The Charlotte Observer, NC, August 2002
- *"Generating Plant to Put Recycled Water to Use"*
  - Inland Valley Daily Bulletin, CA, August 2002
- *"Water at Pueblo, Colorado, Power Plant Slows to Trickle"*
  - The Pueblo Chieftain, CO, August 2002

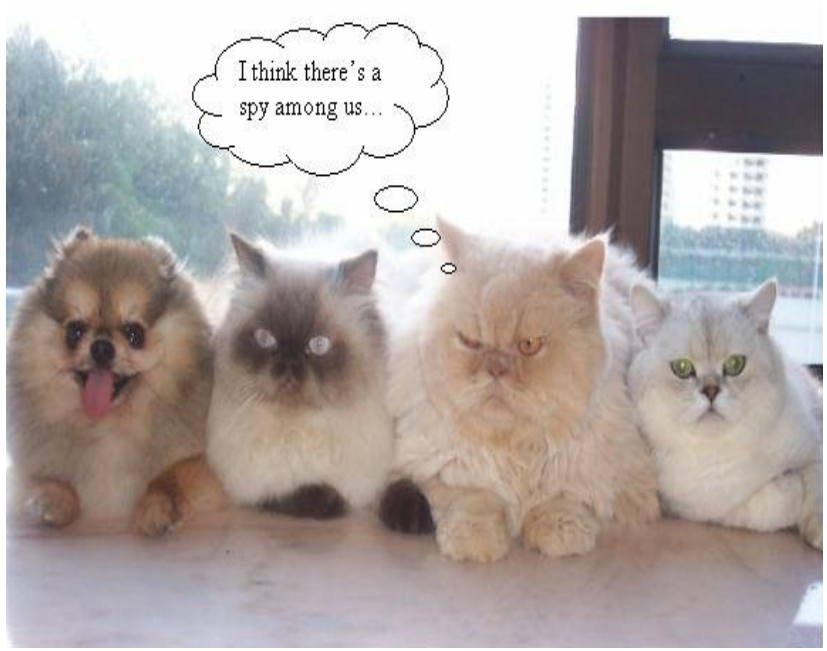
Water is a Critical Resource

- Fast growing demand for clean, fresh water
- Increased demand for environmental protection and enhancement
- All regions of US vulnerable to water shortages
- Water availability determines
  - Electricity supply and demand
  - Electricity grid topology
  - Societal and economic infrastructure sustainability



EPRI Water Resource Sustainability Initiative

- National and international (security) issue
- Integrated macroscale (region and watershed) and microscale (individual facility; e.g., power plant, sewage treatment plant, industrial plant, farm) approach
- Creation and application of
  - New technologies
  - Planning and management stakeholder-accessible tools
- Regional-based strategic partnerships



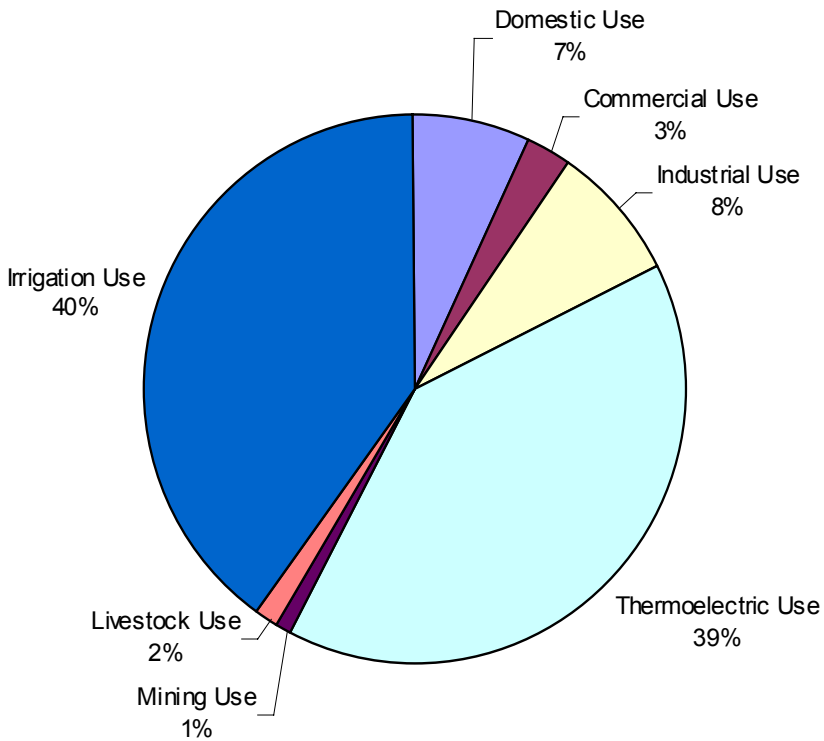
Scoping Reports

- Water & Sustainability (Volume 1): Research Plan (TR-1006784)
- Water & Sustainability (Volume 2): An Assessment of Water Demand, Supply, and Quality in the U.S.—The Next Half Century (TR-1006785)
- Water & Sustainability (Volume 3): U.S. Water Consumption for Power Production—The Next Half Century (TR-1006786)
- Water & Sustainability (Volume 4): U.S. Electricity Consumption for Water Supply & Treatment—The Next Half Century (TR-1006787)
- To order: 800-313-3774

Recent EPRI Energy/Water Sustainability Research Results

- A framework to evaluate demands and availability for electric power production within hydrologic units across the US: development and applications (in review).
- The formation and fate of trihalomethanes in power plant cooling water systems, EPRI 1009486, March 2004 (PIER funded).
- A survey of water use and sustainability in the US with a focus on power generation, EPRI 1005474, November 2003.
- Use of degraded water sources as cooling water in power plants, EPRI 1005359, October 2003 (PIER funded).
- Spray cooling enhancement of air-cooled condensers, EPRI1005360, September 2003 (PIER funded).

Sustainability Indices

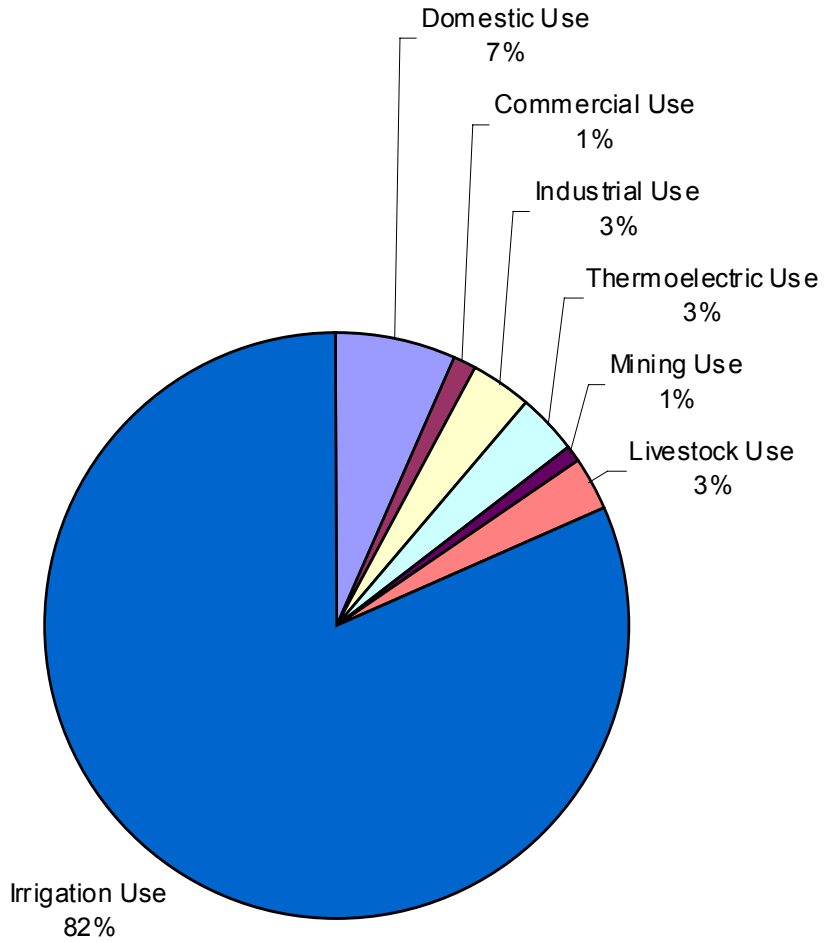


Freshwater Withdrawal (1995)

- Water Supply Sustainability Index
- Thermoelectric Cooling Constraint Index
- Based on easily accessible data
- Include multiple assumptions
- Unquantified uncertainties
- Basis for more detailed analysis of sustainability issues
- A Survey of Water Use and Sustainability in the United States with a Focus on Power Generation (EPRI 1005474)

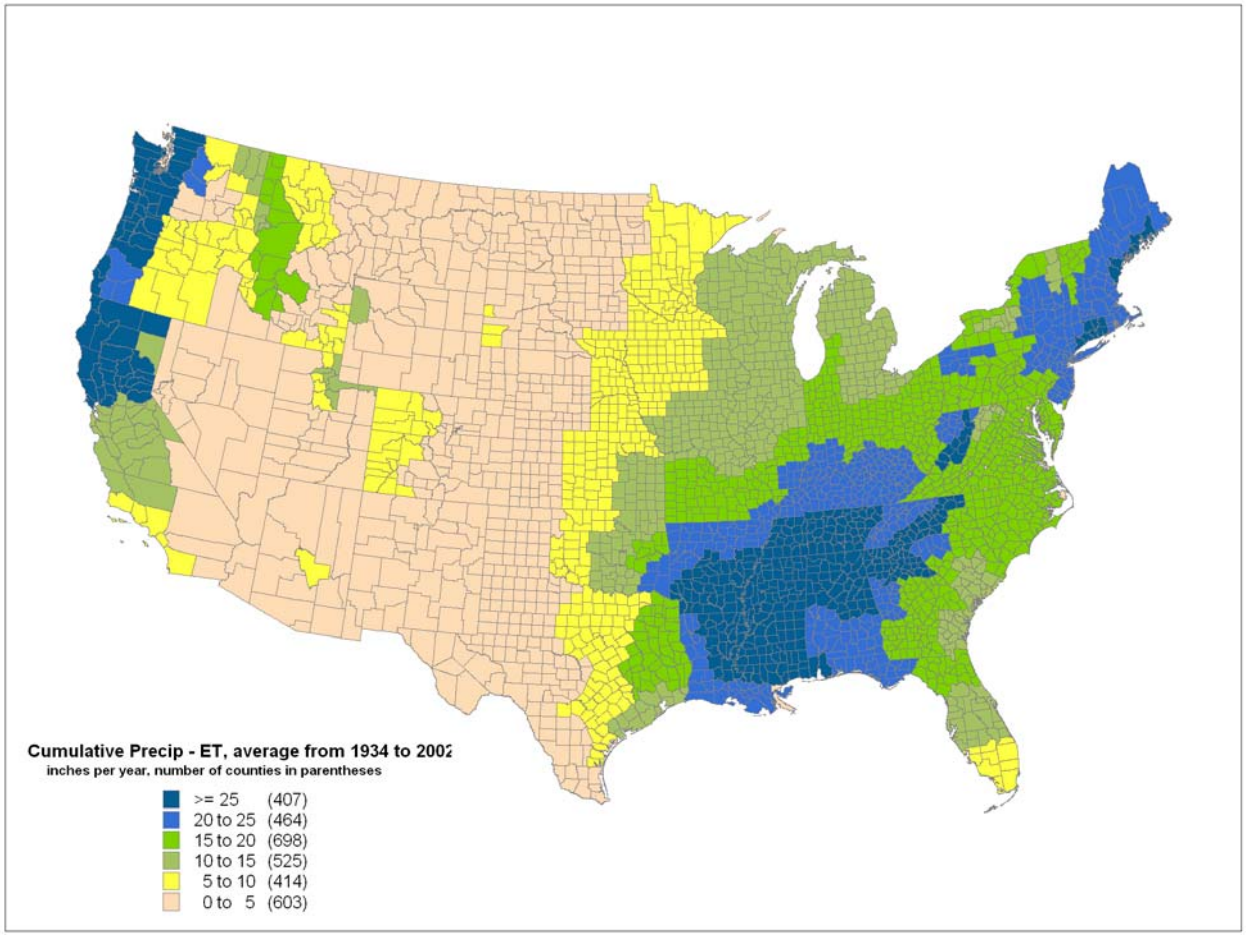
Data Sources

- US Geological Survey
- NOAA
- US Department of Agriculture
- US Census Bureau
- US Department of Energy
- USEPA

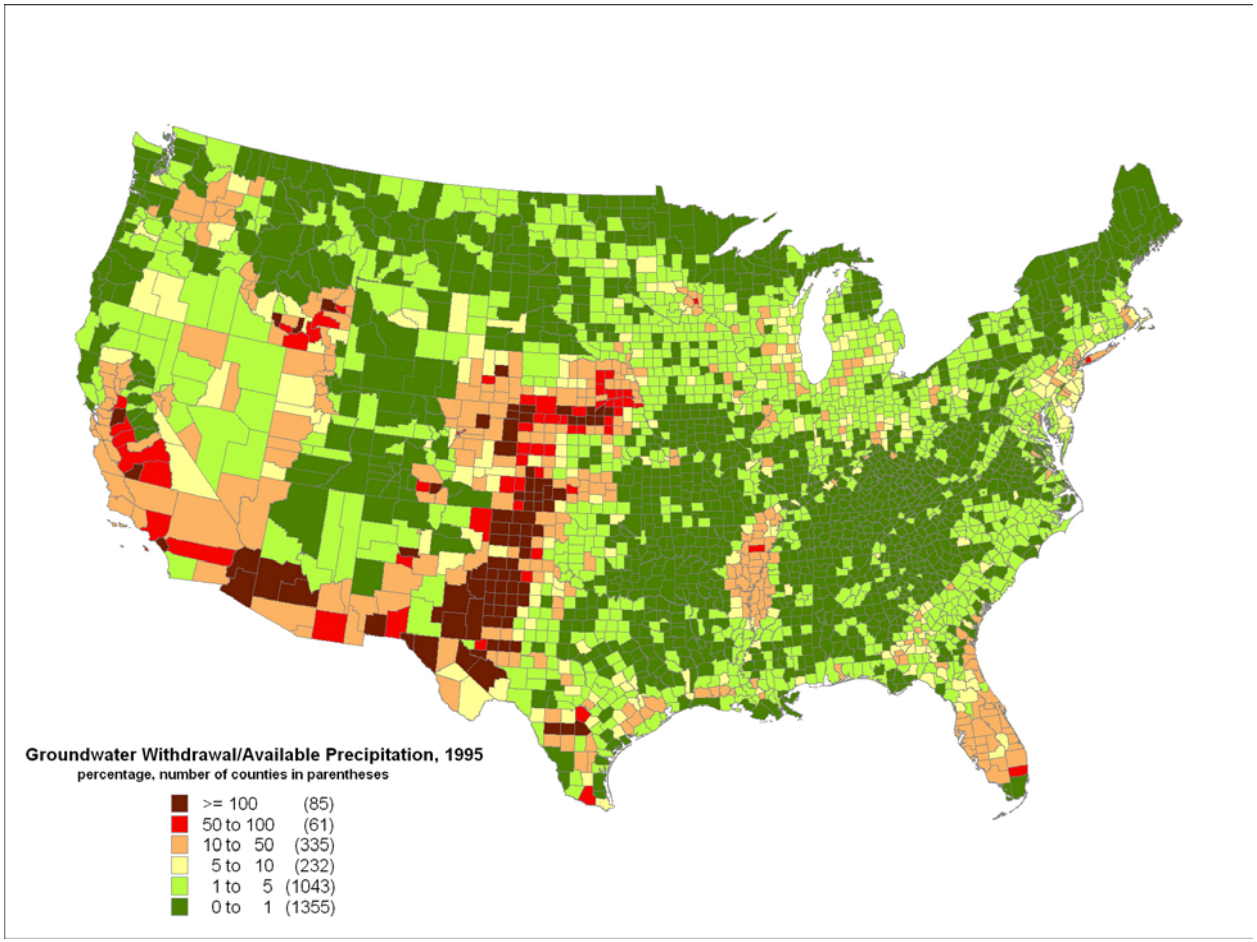


Consumptive Use (1995)

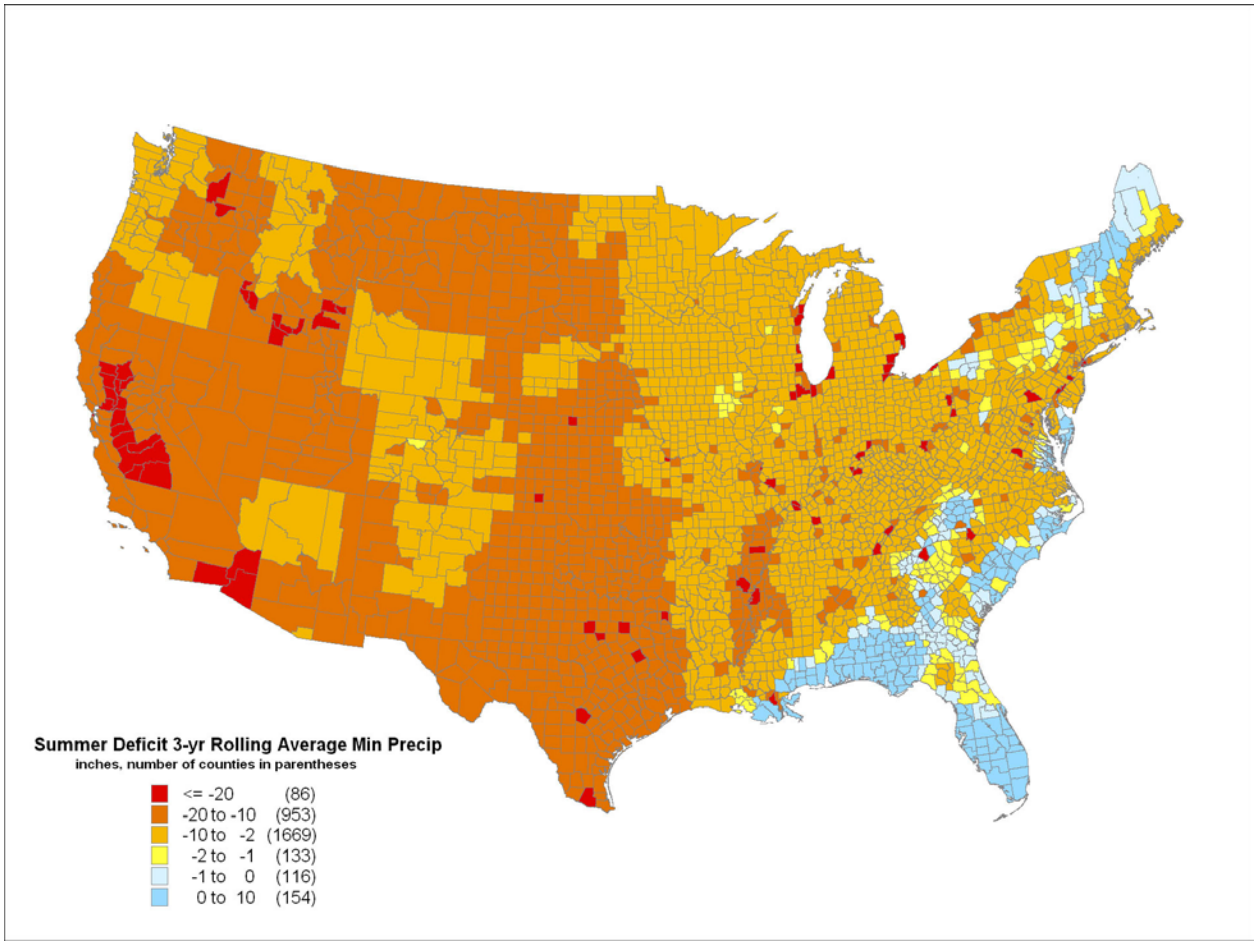
Annual Precipitation Minus ET, Average 1934-2002



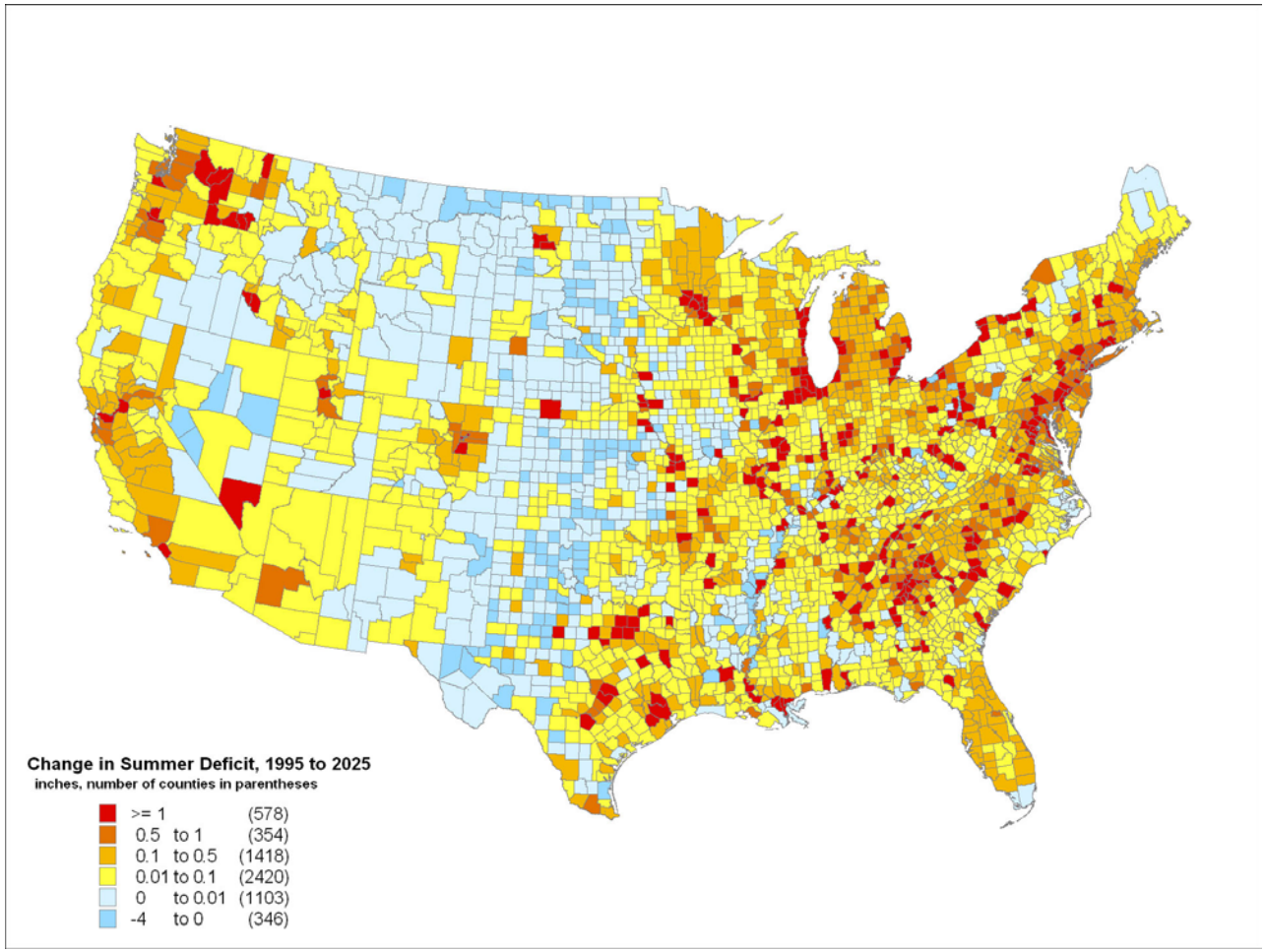
Groundwater Withdrawal/Available Precipitation (1995)



Summer Deficit 1995 Using 3-Year Rolling Average Minimum Precipitation



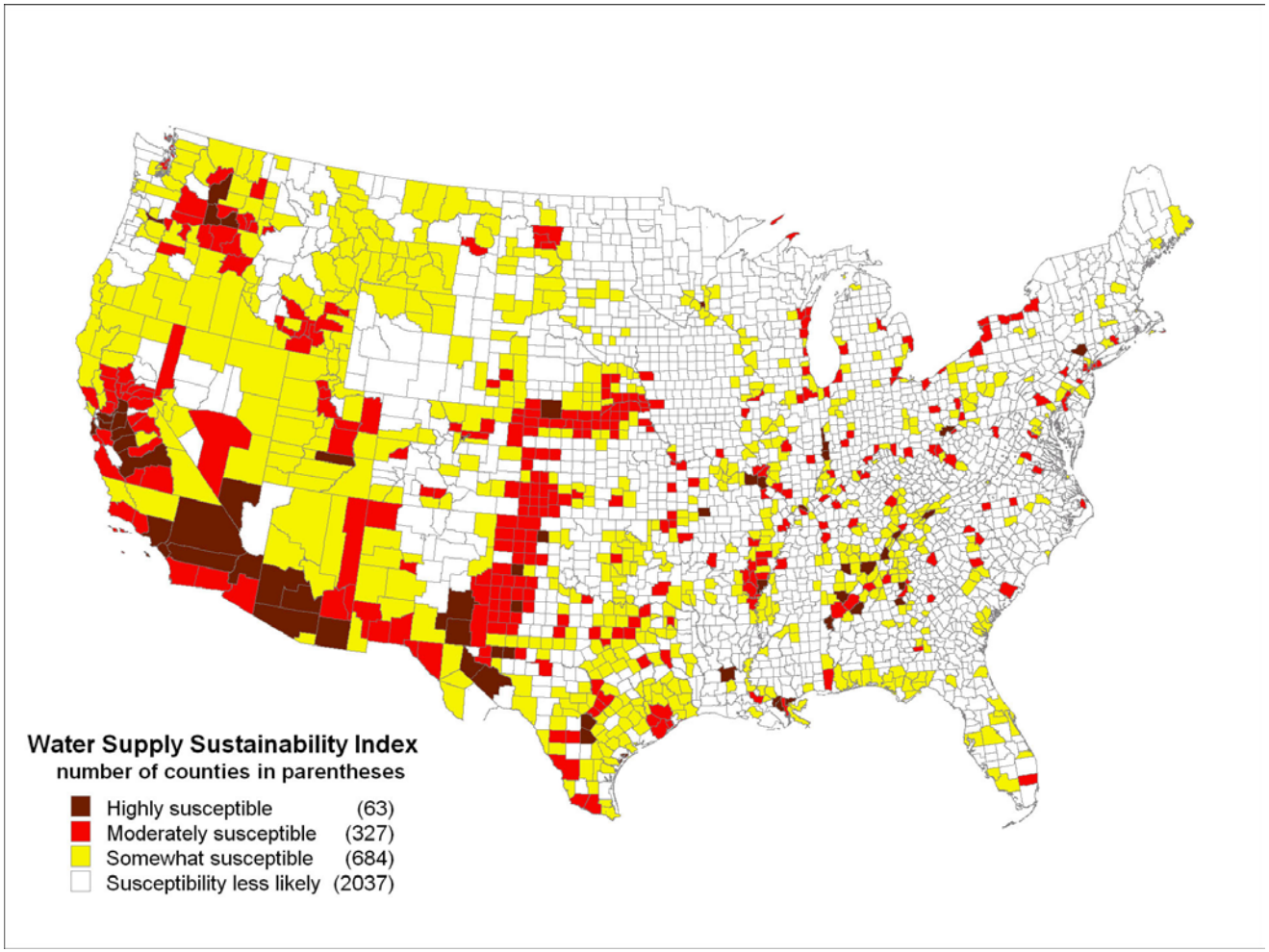
Change in Summer Deficit, Business as Usual, 1995-2025



Water Supply Sustainability Index (2025)

- Extent of development of available renewable water: use of available precipitation more than 25%
- Sustainable groundwater use: ratio of groundwater withdrawal to available precipitation more than 50%
- Environmental regulatory limits on freshwater withdrawals: number of aquatic endangered species more than 2
- Susceptibility to drought: summer deficit during low precipitation years more than 10 inches
- Growth of water use: Increase of freshwater withdrawals from 1995 to 2025 using business as usual scenario more than 20%
- New requirements for storage or withdrawal from storage: increase in summer deficit from 1995 to 2025 more than 1 inch

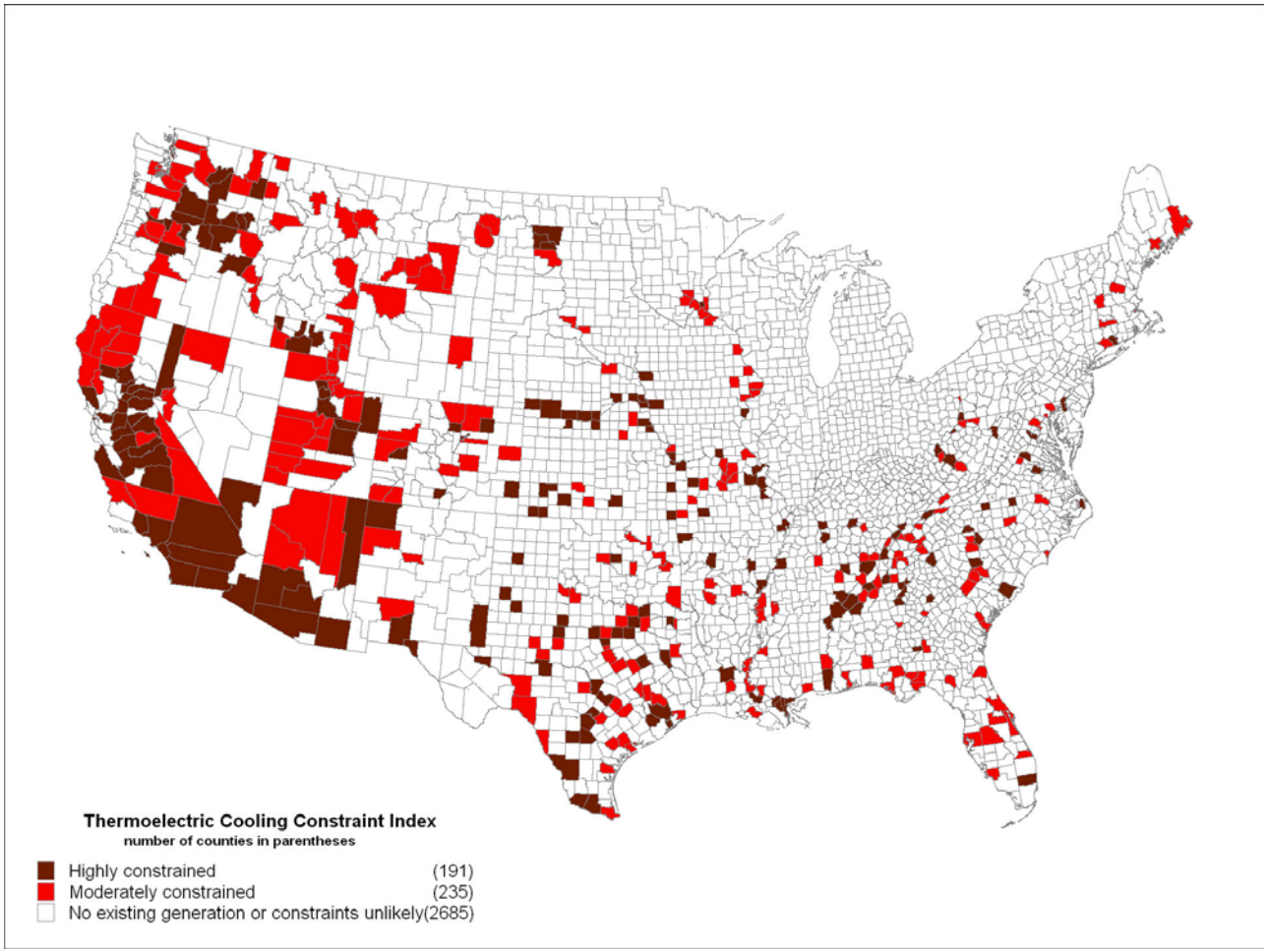
Water Supply Sustainability Index (2025)



Thermoelectric Cooling Constraint Index (2025)

- Water Supply Sustainability Index (WSSI)
- Growth in electricity generation from 1995 to 2025
- Highly constrained
  - WSSI is three or more
  - Generation increases by more than 50%
- Moderately constrained
  - WSSI is two or more
  - Generation increases by more than 50%

Thermoelectric Cooling Constraint Index 2025

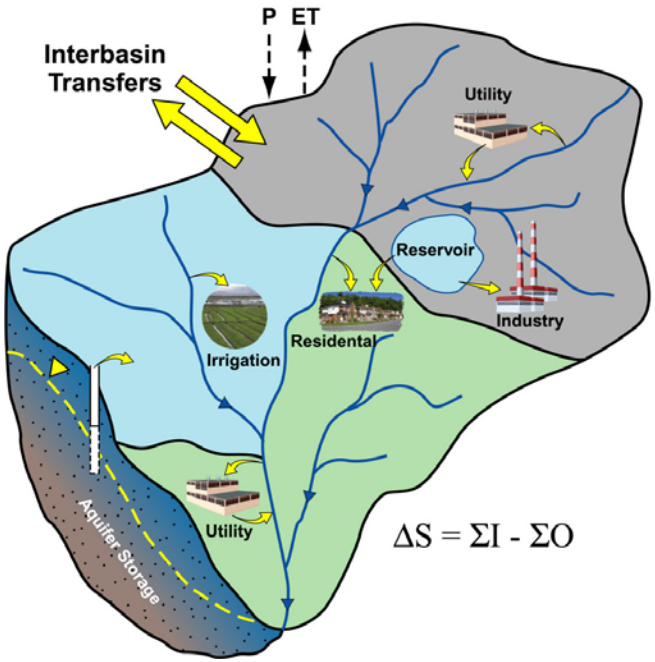


Sustainability Index Study Conclusions

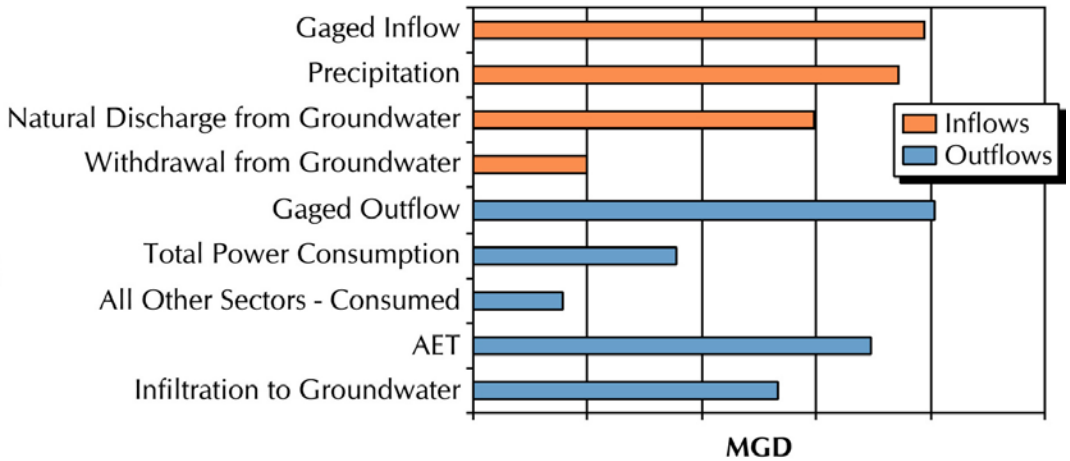
- First step to develop comprehensive framework to:
  - Evaluate possible impacts of water supply limitations on electric power generation
  - Manage approaches to limit these impacts
- Areas vulnerable to shortages of water availability and water-induced constraints on electric power generation occur throughout the U.S.
- Climate change and growing concerns about environmental protection may exacerbate the situation

Water Demands and Availability for Power Generation - Create Annual Water Budgets

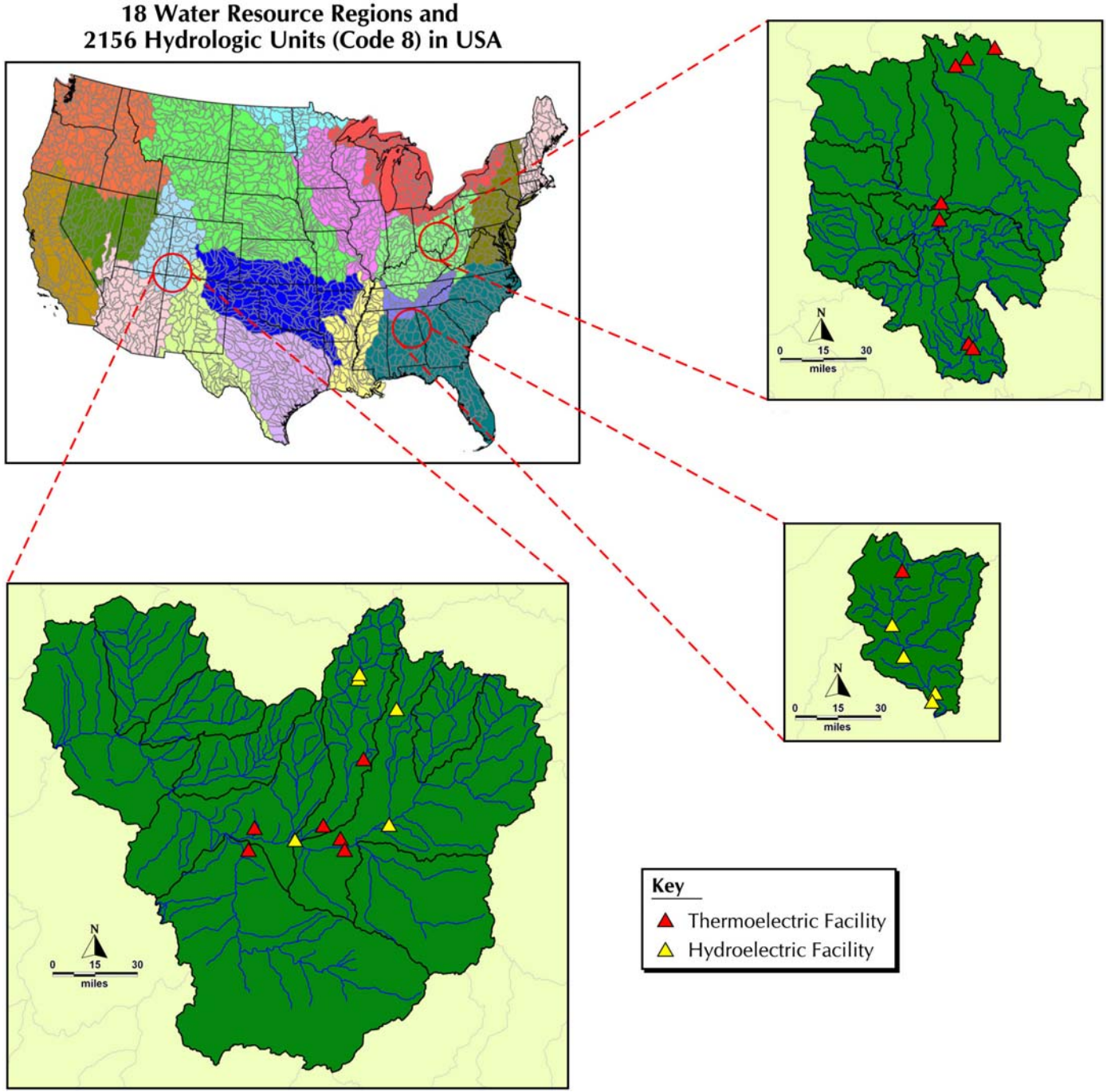
Multi-Basin Water Uses, Storage, and Flows



Typical Water Budget Components



Case Studies: Select Hydrologic Units for Analysis



ZeroNet Initiative

- PNM, LANL and EPRI
- Goal: By 2010 achieve required electric power production and use in New Mexico with Zero-Net fresh water withdrawals for new capacity.
- Comprehensive/Integrated
  - Advanced cooling
  - Degraded water use
  - Efficiency, conservation, recycling and renewables
  - Landscape management
  - Economic and market mechanisms
  - Advanced monitoring
  - Modeling
  - Policy analysis
  - Education
- $50M - 7 years

Questions?